

DISSERTATION ON
BLUNT INJURY ABDOMEN – AN EVOLUTION
OF SOLID ORGONS

M.S DEGREE EXAMINATION
BRANCH-I
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INTRODUCTION

Trauma has come to occupy a prominent position as one of the preventable cause of death. In developed countries trauma to the abdomen is mainly due to road traffic accidents. In our country also it is major health problem. Analysis of these accidents show that mostly alcohol intoxication and violation of traffic rules is the cause in 85 % of cases. Abdomen is the third most commonly injured part of the body next to injuries to extremities and head injuries. Blunt injury to the abdomen causes single organ injury or multiple organ injury according to the severity of the accident. Our Thanjavur District, Granary of South India, due to increased agricultural activities the injury occurred during agricultural work more or less equals to that of road traffic accidents. Hence, the pattern of injury of to the solid organ was also taken as a comparative study of road traffic accidents and agricultural related injuries.

AIM OF THE STUDY

1. To evaluate the impact of blunt abdominal trauma on various intra abdominal solid such as liver, spleen, pancreas and kidney with regard to age, sex and various modes of blunt injuries.
2. To evaluate various associated injuries occurring in blunt abdominal trauma.
3. To evaluate various modes of clinical presentation of cases with solid organ injuries in blunt abdominal trauma with emphasis on the clinical signs as the prime tool in the early diagnosis.
4. To evaluate the value of various available investigations employed for detection of the solid organ injuries in blunt abdominal trauma.
5. To evaluate the common patterns of injury in the blunt abdominal trauma.
6. To analyze various modalities of treatment available for solid organ injuries with an aim to reduce the postoperative morbidity and mortality.
7. To evaluate the common complications associated with solid organ injuries and their management.
8. To compare the incidence and mode of injuries due to agricultural and agricultural related activities with that of road traffic accidents.

EVALUATION OF PATIENT WITH BLUNT ABDOMINAL TRAUMA

History of mode of trauma as well as physical examination remains the important factor in the surgical decision making process. An accurate history of the mode of injury, deceleration, use of restraint device etc. Suggest a possibility of the injured organs (e. g: steering wheel causing duodenal or pancreatic fracture). This problem is more compounded by intoxication and associated injuries like head injury, chest injury etc.

Physical Examination

The general condition of the patient should be evaluated. Abdominal distension, tenderness, guarding, rebound tenderness and rigidity should be looked for.

Frequently signs of hypotension and peritonitis may occur simultaneously.

Abdominal guarding and rigidity signifies intraperitoneal injuries and warrants exploratory laparotomy.

Profoundly hypotensive patients as a rule bleed into one of the four areas viz., pleural cavity peritoneal cavity, retroperitoneum and extremities. Hemorrhage into plural cavity can be ruled out with X-ray chest.

All patient with intra abdominal need emergency laparotomy while retroperitoneal hemorrhage particularly associated pelvic fracture need radiological intervention.

For this reason it is important to differentiate between intraperitoneal and retroperitoneal injuries.

Inspections of the abdominal wall may reveal small abrasions or areas of echymosis and pattern bruise. Right upper abdominal contusion may be associated with fracture right lower ribs, which is associated with liver injuries (5%) . Similarly on the left side fracture of 9 –11 ribs with or without fracture of lumbar transverse process is associated with splenic injuries(20%)

Laboured breathing may be from diaphragmatic irritation. Pain over the left shoulder with inspiration signifies splenic injuries (Kehr sign). Suprapubic tenderness and pelvic lateral wall tenderness are assessed for pelvic fracture. Inspection of external urethral meatus for blood is essential as passage of foley's catheter should be delayed, until radiographic evaluation of pelvis and urethra is made.

Rapid intra abdominal bleeding, secondary to mesenteric artery laceration may be without physical findings except shock. Postural hypotension and marked hypotension are due to loss of blood volume more than 30%. More than 10 mm Hg pressure variations on lying and sitting/standing posture indicates that the patient is having acute bleeding inside. Absence of bowel sounds may be helpful to assess significant peritoneal irritation from blood or intestinal contents.

The incidence of abdominal trauma continues to increase. Although USG and CT Scan and other better diagnostic investigations are available. Mortality is still higher. Spleen and liver are the frequently injured organs seen in our hospital.

Laboratory Investigations

They are of limited use in blunt abdominal trauma. Haematocrit reflects a balance of acute blood loss. Leukocytosis is common but non specific, serum amylase lacks sensitivity and specificity because a normal level can not exclude a major pancreatic injury. Conversely elevations may also occur following trauma to parotid of small bowel.

Blood urea and serum creatinine were done to exclude pre renal azoetemia and pre existing renal disease. Blood sugar was done to rule out diabetes, urine analysis for RBCS, Blood coagulation profile, arterial blood gas analysis may be indicated in patients requiring massive transfusions and who are at risk of developing subsequent pulmonary decompensation.

TABLE 1
CRITERIA FOR EVALUATION OF PERITONEAL LAVAGE FLUID

POSITIVE :	20 Ml gross blood on free aspiration (10 ml in children) Greater than or equal to 1,00,000 RBC/CC Greater than or equal to 500 WBC/CC(if obtained 3 hours after the injury) Greater than equal to 175 IU amylase/ dl. Bacterias on gram stain Bile (by inspection or chemical determination of bilirubin content) Food particles (microscopic analysis of stained or spun specimen)
INTERMEDIATE :	Pink fluid on free aspiration 50,000 to 1,00,000 RBC/CC in blunt trauma 100 to 500 WBC / CC 75 to 175 IU amylase/dl.
NEGATIVE :	Clear aspirate Less than or equal to 100 WBC/CC Less than or equal to 75 IU amylase/dl.

Abdominal Paracentesis

Under aseptic precaution using a sterile 18 G needle peritoneal tapping done on all four quadrants. Paracentesis is considered positive when the aspirate contains

1. Blood
2. Intestinal contents
3. Bile
4. Food particles

This is a rapid bed side investigation but false negative results are very high ranging as high as 35-40 %

Diagnostic Peritoneal Lavage (DPL)

Introduced by Root **et al** in 1965. It is a rapid, inexpensive and relatively safe procedure. Lazarus – nelson catheter or standard peritoneal dialysis catheter is used. Abdominal paracentesis can be used when intraperitoneal haemorrhage is suspected. A negative result is of no diagnostic significance and hence diagnostic peritoneal lavage is the standard technique used to detect intra peritoneal haemorrhage (Root et al). The criteria for evaluation of peritoneal lavage fluid is given in Table – 1.

Indications for DPL

1. unconscious patient with abdominal injuries- alcoholics, head injury patients.
2. Suspected high energy transfer
3. Unexplained shock
4. abdominal findings which are equivocal and investigations are not contributory
5. Patients with physical findings such as abrasion of the thoracic or abdominal wall or who has fracture ribs or pelvis.

Contra indications**Relative**

1. Gravid uterus
2. Previous abdominal operation
3. Abdominal wall haematoma

Absolute

1. Patients with obvious indication for laparotomy.

Pelvic radiograph should be taken before lavage. False positive results may be obtained by passing through haematoma associated with fracture.

Radiological Findings

X-ray chest AP view and plain X-ray abdomen AP view in erect posture provides a clue to the associated thoracic and diaphragmatic injury. Small amount of free air under the diaphragm may be detectable in associated hollow viscus injury. Extensive haemoperitoneum may produce ground glass appearance. The injured spleen may displace the fundal air shadow or indentation of the splenic flexure of colon.

A minimum of 800 ml of intra peritoneal body is required to be evident on plain abdominal radiographs, the specific signs are

1. **Flank strip sign** : A fluid dense zones separating the ascending and descending colon from a distinctly visible lateral peritoneal wall.
2. **Dog ear sign** : Results from accumulation of blood that gravitate between the pelvic wall on each side of the bladder
3. **Hepatic angle sign** : Loss of definition of the definite inferior and right lateral borders as blood accumulates between hepatic angle and right peritoneal wall.

Ultrasonogram

The advantages are

1. Non invasive
2. Readily available
3. Able to detect intraperitoneal and retro peritoneal collections of blood.
4. Accurately delineating solid organ injuries.
5. Demonstrate the extent and precise locations of solid organ haematoma.
6. Because it involves no hazard from radiation or contrast media the procedure is particularly appealing for pediatric trauma.

The disadvantages are

1. Low specificity
2. Poor localization in obese and in hollow viscus injury
3. required immediate availability of sonologist.
4. Observer dependent

CT Scan

Computed Tomography plays an important role in the evaluation of blunt abdominal trauma when applied in an appropriate clinical setting. The safe and timely completion of CT is a critical issue. It takes 30-45 minutes for completing the study. It can reveal intraperitoneal and retro peritoneal haemorrhage and specifically identify the injured solid gram. Selected patients with self limiting injuries of the liver, spleen and kidney can be managed expectantly.

Indications

1. Stable patient with closed head or spinal cord injury
2. Stable patient with equivocal injury
3. Patients with Haematuria
4. Pelvic fracture with a need to rule out intraperitoneal associated injuries.
5. Patients with delayed presentation who are haemodynamically stable and do not have overt signs of peritonitis
6. Patients in whom DPL is difficult to perform (morbid obesity, late term pregnancy)
7. Patients at high risk for retro peritoneal injuries in whom DPL is unremarkable.

Advantages

- 1 Quantitate the amount of free fluid
- 2 To know the extent of visceral injuries
- 3 To evaluate retro peritoneal organs such as kidney and pancreas.
- 4 To avoid surgery in stable patients, with minimal hepatic, splenic or renal injury
- 5 When there is a consideration for DPL

Disadvantages

- 1 Requires specialized Technician
- 2 Cost factor and maintenance
- 3 Requires contrast enhancing agents
- 4 Un-cooperative patients compromising accuracy

Intra Venous Urography

IVU is indicated in patients with suspected renal injuries. Its main indications are gross haematuria or Haemodynamically unstable patients with microscopic haematuria.

CT Scan with contrast is more specific than IVU. IVU is not regarded as a diagnostic screening test of choice. It should be followed by CT or Arteriography.

The purpose are to identify irreparable parenchymal injury. Rene vascular occlusion and to know the functional status of the other kidney. Contraindications are allergy to the dye. Relative contra indications are multiple myeloma and old age.

Arteriography

The primary indications are intraabdominal solid organ and pelvic arterial bleeding with pelvic fracture. Therapeutic embolisation can be done. Abdominal arteriograms are indicated when there is persistent bleeding from abdominal solid organ and haematuria. The common complications are allergy and arterial thrombosis. The contraindications are obvious need for laparotomy and uncooperative patients.

Radio Nuclide Scan

Its use has diminished in recent years because of the availability of CT scan in major trauma centers and the specificity is limited in most of the trauma cases.

At present it is indicated

1. In patients with diminished flow to one kidney in IVU to avoid further infusions of nephrotoxic dye.
2. In postoperative period to evaluate flow to a kidney after major repair of a renal artery.
3. To document location of biliary fistula after repair of hepatic injuries.

Laparoscopy

Direct visualization of intra abdominal viscera and retro peritoneum can be done. Abdominal cavity was inspected a standard fashion beginning with the liver and right diaphragm in right hypochondrium proceeding in a clockwise manner. Because of the time and availability of techniques with similar accuracy it is infrequently utilized now a days. The sensitivity is very low with splenic injuries, small bowel injuries and in the presence of haemoperitoneum.

The patients are to be evaluated according to the algorithm based on the mechanism of the injury as well as physiological status (Figure-1)

LAPAROTOMY

Use a vertical paramedian or midline incision. Examine every organ in order. Often more than one organ is damaged. When the peritoneum is opened massive haemorrhage is encountered.

Deliver the small intestine and evacuate the clots. If bleedings is repaid pack with large gauze packs. Remove them slowly and control each bleeding point in turn. Exploratory laparotomy is to be done adopting procedures that decrease operative time.

Procedures that decrease operative time with major abdominal trauma.

1. Perihepatic packing
2. Single layer bowel closure
3. Colonorrhaphy instead of resection
4. Avoid placement of drains.
5. Pyloric exclusion instead of resection.

Procedures that decrease post operative abdominal sepsis.

1. Hepatotomy and resectional debridement instead of mattress sutures.
2. Splenorrhaphy instead of splenectomy.
3. Colonorrhaphy instead of colostomy
4. Avoiding placement of drains

Indications for Laparotomy

- Copious blood on peritoneal lavage
- Patterned abrasion or shoulder tip pain
- Continuing shock despite resuscitation
- Subphrenic gas
- Signs of spreading peritonitis.

REVIEW OF LITERATURE

Surgical Anatomy of Solid Organs of Abdomen

Spleen

Spleen is the largest lymphoid organ developed for mesenchymal differentiation along the border of the dorsal mesogastrium. It lies under the diaphragm on the left side of the abdomen closely in contact with 9th, 10th and 11th ribs. It lies along the long axis of 10th rib. It weights about 100 to 150 gms. Spleen is held in position by lienorenal ligament, gastrosplenic ligament and phrenico colic ligament. It is dull red in colour, freely mobile, measures 1x3x5 inches, size and shape resembles roughly of clenched fist.

Spleen is supplied by splenic artery, which divides into upper and lower branches at the hilum and then into segmental arteries supplying the segments of spleen. Spleen is drained by splenic vein. Hilum of spleen is closely related to the tail of pancreas.

Liver

Liver lies in the right upper quadrant of the abdomen beneath the diaphragm and connected to the digestive tract via the portal vein and biliary drainage system. It is the largest intra abdominal organ weighing about 1500 gms. The superior or diaphragmatic surface conforms to the under surface of the diaphragm. The inferior surface is in contact with duodenum, colon, right kidney, right adrenal, oesophagus and stomach. In adult the normal liver extends upto right 5th intercostal space in right midclavicularline.

Liver is held in place by attachment of IVC and hepatic veins. French system (Couinaud) divides liver into eight surgical lobes according to the blood supply. Right and left lobes are divided along the line passing through the medial aspect of the gall bladder bed and IVC.

Blood supply is from the hepatic and portal system, supplying 25% and 75% respectively but the oxygen is supplied mainly by hepatic arterial blood. Liver is drained by right, left and middle hepatic veins. Bile is synthesized and excreted in the liver and is carried in the right left hepatic ducts which joins to form common hepatic duct.

The liver gets injured because of its position in the abdomen being compressed between the ribs and vertebrae. The right lobe is commonly injured than the left because of its larger size and its position. Deceleration injuries are common because of its anatomical attachment. The ligaments attached to the liver are right and left triangular ligaments, Coronary ligament, falciform ligament and lesser omentum. Pringle's maneuver is the temporary compression of hepatoduodenal ligament in the free margin of lesser omentum to occlude hepatic artery, common bile duct, and portal vein, which are present in the free border of lesser omentum. Non-crushing clamps may be applied for 20 minutes to one hour. It is indicated in arresting major bleeding from hepatic and perihepatic injury. Topical cooling, intravenous methyl prednisolone 30-40 mg/kg have been found to protect the hepatocytes during clamping.

Pancreas

Pancreas occupies a retro peritoneal position in the abdomen lying posterior to the stomach and lesser omentum. Pancreas was originally thought to act as a cushion for the stomach. It is a composite gland whose exocrine acini discharge their secretions into the duodenum to assist in digestion. The islets of langerhans, a group of endocrine cells in the pancreas plays a special role in the metabolism of carbohydrates.

The gland is retort shaped, length varying from 10 to 20 cms, weighing about 75 to 125 gms, distinct yellow, tan or pink coloured, soft with finely lobulated surface.

The gland is divided into

1. Head moulded into the 'C' shaped concavity of the duodenum
2. Neck
3. Body and
4. Tail

it is covered anteriorly by peritoneum with attachment of transverse mesocolon. Posteriorly it lies in close proximity to IVC, right vein, aorta at the level of first lumbar vertebra, superior mesenteric vessels and splenic vein.

Pancreatic duct is a continuous tube leading from the tail to the head draining the upper part of head, neck, body and tail. Accessory pancreatic duct drains the lower part of head and uncinat process.

Kidney

Kidneys are retroperitoneal organs situated higher up in the posterior abdominal wall under cover of the costal margin. Kidneys are protected posteriorly by psoas and quadratus lumborum, anteriorly by peritoneum and abdominal viscera. Kidney was surrounded by cushioning perinephric fat and Gerota's fascia.

The normal kidney measures about 12x6x3 cms and weights about 130 gms each. The right kidney is at a lower level because of the bulk of the liver. Each kidney exhibits a vertical mobility of 2cm during full inspiration. All surfaces are smooth and convex. The hilum lies over the psoas muscle. The pelvis emerges from the hilum behind the vessels to pass down and become the ureter.

Kidneys are supplied by renal arteries. Based on blood supply each kidney is divided into five segments-apical, upper, middle and lower segments which are supplied by anterior division and posterior segment supplied by posterior division of renal artery.

PATHOPHYSIOLOGY PF BLUNT INJURIES

Management of patient with blunt abdominal trauma requires and understanding of the injury mechanism. In general injuries can be classified as high energy or low energy. Several pathophysiological processes involved are

1. Sudden pronounced rise in intra abdominal pressure causing burst injury of solid organs or rupture of hollow viscus.
2. Compression of abdominal viscera the applied force to the anterior wall to the posterior thoracic cage or vertebral column.
3. Abrupt, shearing forces can cause tear of organs or vascular pedicles

SPLENIC INJURIES

Deceleration type of motor vehicle accident, direct blow to the left lower ribs or left upper quadrant of abdomen are common modes of injuries to spleen. Spleen remains the most commonly injured organ in patients who suffered blunt abdominal trauma because of its mobility, its attachments to many of the structures in the left hypochondrium and its position and intimate contact with 9th, 10th and 11th ribs. Spleen is relatively free to continue movement in patients who suffered deceleration type trauma and this leads to capsular tears at the attachments and possible fractures by contact with the convex outer dome against the posterior lower ribs. Splenic injury is more common in patients with diseased/enlarged spleen.

Clinical Manifestations

Approximately one third of the patients with splenic ruptures presents with modest hypotension. Signs of peritonitis in the left hypochondrium are present in 50 to 60% of patients; Kehr's sign or pain at the tip of the shoulder is present in less than 50% of the patients. Balance sign or fixed dullness in

the left upper quadrant with shifting of dullness in other areas of abdomen is rarely elicited.

Some patients present with signs and symptoms of splenic rupture sometime after original injury. This period is the latent period of Baude6t, reasons for this is the rupture of the larger subcapsular haematomas in delayed fashion.

Local bruising and tenderness in the left upper quadrant is common. Abdominal guarding present in 50% of patients. Perrectal examination usually shows a bulge.

LIVER INJURIES

Hepatic injuries result from blows, compression between the lower ribs on the right and the shearing at fixed points secondary to deceleration. These types of injuries most commonly result from motor vehicle collisions. Right lob is more commonly involved than the left lobe because of larger size and lesser mobility.

Clinical manifestations

Hepatic trauma is suspected in a patient with the location of trauma in right upper quadrant, profound hypotension temporarily responding to infusion of blood and fluids and marked abdominal distension.

PANCREATIC INJURIES

Blunt injuries to the pancreas generally result from direct blows to the upper abdomen. The pancreas extends across the upper abdomen and for this reason direct blows results in a variety of injuries which ranges from simple capsular contusions to ductal transactions over the spine to major lacerations in the head or tail. Difficulty in diagnosing injuries to pancreas are due to

1. Minimal clinical signs and symptoms
2. Retroperitoneal location of the organ
3. Temponading effect of the retroperitoneum
4. DPL will not be helpful.

RENAL INJURIES

Blunt renal trauma usually is associated with sudden deceleration of the human body. Motor vehicle accidents of all types, fall from height or blunt physical contact are the most common causes of this type of injuries. Fractured ribs or fractured upper lumbar vertebrae transverse processes may lacerate or contuse renal parenchyma. Deceleration or crush injuries may thrust the kidneys internally against the rib cage or externally against steering wheel or dashboard of a vehicle producing contusion or laceration. Renal arteries intimal tear or disruption of the ureteropelvic junction are unique to deceleration renal injuries.

Haematuria has been the most reliable sign of renal injury and its presence in any degree has been advocated as an indication for radiological evaluation. The degree of haematuria do not correlate with severity of injury. The indications for radio logic assessment of the kidneys are

1. Gross haematuria
2. Microscopic haematuria with blunt trauma with features of shock.

Physical examination may reveal an upper abdominal or flank tenderness, contusion or palpable mass and crepitation over lower rib cage or lumbar vertebrae.

MANAGEMENT AND COMPLICATIONS

SPLENIC INJURES

The abnormalities noted in plain X-ray of the abdomen on splenic injuries are

1. Elevation of left hemi diaphragm and immobilization of the diaphragm in fluoroscopy.
2. Enlargement of the splenic shadow
3. Medial displacement of the gastric air shadow.
4. Widening of the space between the splenic flexure and the preperitoneal pad of fat.
5. Associated rib fractures if any.

The ultra sonogram can detect haemoperitoneum and splenic injuries. CT Scan is more useful in clearly demonstrating the low-density bands produced by defects in the parenchyma and sub capsular haematomas as low density lesions in the periphery. Significance of radionuclide imaging has declined after the availability of modern CT Scan. False positive findings can occur in CT Scan and radionuclide scan due to presence of congenital clefts. Arteriography is highly accurate in identifying disruption of parenchyma and extravasation of radio opaque dye into the peritoneal cavity. The grading of splenic injury is given in Table 2.

Table 2	
SPLENIC INJURY SCALE	
GRADE	INJURY DESCRIPTION
I	Haematoma - Subcapsular, non expanding < 10 % surface area Laceration - Capsular tear, non bleeding < 1cm Parenchymal depth
II	Haematoma - Subcapsular, non expanding 10-50% surface area intra parenchymal non expanding < 2cm in diameter Laceration - Capsular tear, active bleeding
III	Haematoma - Subcapsular > 50 % surface area or expanding ruptured subcapsular haematoma, active bleeding - Intra parenchymal haematoma > 2 cm or expanding Laceration - > 3 cm parenchymal depth or involving trabecular vessels
IV	Haematoma - Reputed intra parenchymal haematoma with active bleeding Laceration - Laceration involving segmental or hilar vessels producing major devascularisation (>25 % of spleen)

Treatment

The immunologic importance of the spleen was first recognized by Morris and Bullock in 1919. It is now generally accepted that spleen has at least four major activities.

1. Maintenance of elements of blood
2. Clearing particulate matter from the blood stream.
3. Synthesis of antibody and related substance such as IgM, tuftsin, opsonins and properdins.
4. Acting as an important component of the immunosuppressor system and possible as a reservoir of suppressor cells.

For maintaining these functions splenic conservation procedures are now attempted.

Non-operative Management

It is indicated in

1. Those who had no period of haemodynamic instability.
2. Those without peritoneal findings at any time.
3. Those who did not require greater than two units of bloods.

The major concerns about non-operative management are

1. Risk of transfusion associated hepatitis.
2. Missed injury to other viscera.
3. Delayed rupture of sub capsular haematoma.

Sequential radionuclide scans or CT Scan examinations are required to monitor complete healing.

Spleen conservation Procedures

This may be in the form of

1. Topical application of haemostatic agents.
2. Splenorrhaphy with or without topical agents especially in paediatric age group.
3. Hemisplenectomy or partial splenectomy.

Topical Agents

Topical haemostatic agents like surgical (oxidized regenerated cellulose) or Avitane (microfibrillar collagen haemostat) or gel foam can be applied over small capsular tears or avulsions with moderate bleeding under a dry laparotomy pads and pressure maintained for 5 to 10 minutes. Alternatively fibrin glue can also be used.

SPLENORRHAPHY

It is indicated in

1. Stable patients with few associated intra abdominal injuries especially in children.
2. Grade 1-4 magnitude of injuries to spleen

It is contraindicated in

1. Patients with splenic injury who has been previously noted to require splenectomy.
2. Patients with diseased spleen like tropical splenomegaly.

Parenchymal fractures or lacerations are best repaired with horizontal mattress suture using 0,00 or 000 chromic catgut. The capsular tearing may be minimized by placing the sutures over a viable pedicle of omentum or Teflon pledgets. When there are several large parenchymal lacerations,

poly glycolic acid mesh or a through and through horizontal mattress sutures using spiral needle may be applied.

PARTIAL SPLENECTOMY

It is indicated in patients when there is avulsion of superior or inferior pole of the spleen or injury to the splenic hilar vessels. The segmental branch to the devascularised pole should be ligated first. Then the non viable portion can be removed from the viable portion by using electrocautery.

SPLENECTOMY

It is indicated in

1. Hypotensive patients
2. Multiple associated intra abdominal injuries
3. Shattered or avulsed spleen.
4. Failure of splenorhaphy

COMPLICATIONS

The common complications are

1. Left Lower lobe atelectasis
2. Left pleural effusion
3. Seroma in the left upper quadrant.
4. Left sub phrenic abscess
5. Overwhelming post splenectomy sepsis occurs in less than 2.5% of patients.

This results from encapsulated microorganisms such as pneumococci, meningococci and haemophilus. The incidence is greatest within two years after injury.

TABLE 3
GRADING OF HEPATIC INJURIES

GRADE	-	INJURIES DESCRIPTION
I	Haematoma	- Subcapsular, non expanding ,< 10 % surface Area
	Laceration	- Capsular tear, non bleeding < 1 cm deep
II	Haematoma	- Subcapsular non expanding, 10-50 % intraparenchymal, non expanding
	Laceration	- < 3m parenchymal depth < 10 cm in length
III	Haematoma	- Subcapsular > 50 % surface area, expanding ruptured intra parenchymal, haematoma with active bleeding
	Laceration	- > 3 cm parenchymal depth.
IV	Haematoma	- Ruptured central haematoma
	Laceration	- Parenchymal disruption involving 25 to 75 % of hepatic lobe
V	Laceration	- Parenchymal destruction > 75 % of hepatic lobe

Results and Mortality

In patients with poly trauma-undergoing splenectomy the morbidity is 20%. The mortality following splenectomy varies depending on the mechanism of injury. It ranges from 10-20% in recent series. The commonest cause of mortality is due to associated injuries like head injury etc.

The splenorrhaphy was done in 40-50% of patients. The incidence of rebleeding was 1.6%.

Liver Injuries

Plain X-ray abdomen will show altered liver border, haemoperitoneum and associated rib fractures if present. Abdominal paracentesis may reveal haemoperitoneum. DPL is diagnostic of minimal haemoperitoneum although it is not specific for liver injury. CT is indicated in stable patients with multiple injuries. The main indication for arteriography in hepatic injuries is in patients with continued bleeding in the early postoperative period and in late haemobilia. Radionuclide scan is not routinely done. Hepatic iminodiacetic acid (HIDA) scan has been successfully utilized to document the location of biliary fistula after repair of hepatic injuries.

Treatment

Grading of the hepatic injury is shown in Table-3.

I. Non-operative approach

It is attempted in patients who are haemodynamically stable and have no obvious indications for laparotomy.

CT Scan criteria for non-operative approach includes.

1. Simple hepatic parenchymal laceration or intrahepatic haematoma.
2. No evidence of active bleeding.
3. Intraperitoneal blood loss 250 ml.
4. Absence of other intraperitoneal injuries.

CT Scan examination should be done at regular intervals during the period of observation. Patients should be placed on bed rest, nothing by mouth, nasogastric aspiration and antibiotics. If there is continuing haemorrhage arteriography and selective embolisation is indicated.

Indications for laparotomy during the period of observation are

1. Continuing need for blood transfusion or deteriorating vital signs.
2. Increasing abdominal tenderness or peritoneal signs.
3. Progressive expansion of the haematoma.
4. Haematoma thought to represent a septic focus.

II. Simple Techniques of repair

1. Drainage of non-bleeding injuries

Rarely performed now a days because any avulsed biliary ducts or bleeding small vessels can be directly visualized and suture ligated.

2. COMPRESSION

Small cracks in the capsule or superficial lacerations such as might be associated with trauma to the overlying ribs can be treated by compression for 5 to 10 minutes.

3. Topical agents

Topical agents can be used to stop bleeding. The topical agents used are surgical, microfibrillar collagen and gel foam. Fibrin glue is a autologous highly concentrated human fibrinogen and clotting factors to which aprotinin, a fibrinolysis inhibitor is added. Fibrin glue can be used. This remains insitute for two to four weeks and lacks significant tissue reactivity. Drainage is not necessary in the absence of further haemorrhage or any obvious bile leak.

4. Suture Hepatorrhaphy

This is done in class II parenchymal lacerations, which account for more than 50% of all hepatic injuries, which was not controlled with other measures. Classically horizontal mattress sutures with 0 chromic catgut often place with blunt needle is used. A continuous suture of 0 chromic catgut can also be used. With these measure most of the bleeding stops except when a severe coagulopathy is present.

III. Advanced Techniques of Repair

Class III and Class IV injuries of blunt trauma advanced techniques.

1. Extensive Hepatorrhaphy

it refers to the use of multiple deep horizontal mattress sutures in the parenchyma. Its use has diminished in the last 5 to 10 years because bleeding from hepatic artery, portal vein and hepatic veins were often non-controlled and intra hepatic haematomas and abscesses were occurring. This also results in extensive hepatic necrosis, which results in postoperation liver failure, haemobilia can also result.

2. Hepatotomy with selection vascular ligation

The basic principle of hepatotomy is to do whatever is necessary to obtain the exposure of the deeply placed bleeding vessel with Pringle maneuver in place. The edges are retracted and the base is inspected for bleeding vessels. If not visualised the surgeon must use finger fracture or some other blunt technique to divide the liver parenchyma in line with the laceration and the bleeding vessel identified and ligated. Failure in arrest of bleeding with these measures strongly suggests injury to retrohepatic venacava or major hepatic veins.

3. Omental Pack

Omentum is placed into deep lobar lacerations to control haemorrhage. The purpose of the omentum is to act as a filter. The omentum, will create tamponade of small bleeding vessels and aid in the absorption of a modest amount of necrotic hepatic tissue and clots which results in decreased incidence of post operative perihepatic abscesses. Omentum is mobilised from the transverse colon and the vascularised pedicle is loosely placed over the liver lacerations or hepatotomy site and loosely fixed with chromic sutures.

4. Resectional Debridement with selective vascular ligation

indicated whenever there is loose friable and partially devascularised hepatic tissue on the edge of the liver. It is preferred than hepatic resection which frequently scarifies large amounts of normal hepatic tissue. It is done by finger fracture technique just outside the area of injury and the feeding vessels are clipped or ligated when they are still intact.

5. Resection

Resection refers to anatomic removal of a hepatic segment or a lobe.

The indications are

1. When there has been total disruption of a segment or a lobe when it is the only technique that will control life-threatening haemorrhage.
2. When the extent of haemorrhage precludes the use perihepatic packing.

6. Selective Hapatic Artery Ligation

This is done based on the fact that higher oxygen saturation in the portal veins of the humans, absence of portal bactermia in humans and extensive collateral arterial flow. This technique is primarily indicated when selection clamping of the extra lobar hepatic artery causes association of arterial bleeding and when the injured vessel cannot be visualized inside the liver. If right hepatic artery is ligated it is safe to perform cholecstectomy also.

7. Perihepatic Packing

This technique involves the insertion of laparotomy pads or rolls of gauze around the injured liver and not into the lacerations. It is indicated in

1. Lack of facilities – blood or experience
2. Transfusion induced coagulopathy.
3. Continued bleeding after routine measure and the patient is not fit for resection.
4. Bilobar injury
5. Subcapsular haematoma
6. Need to terminate operation because of profound hypothermia.

Pack removal is safe when coagulopathies, hypothermia and aciduria were corrected. This can be done as soon as 12 hours after packing.

1. Compression of the superior vena cave with secondary oliguric renal failure.
2. Increased incidence of perihapatic sepsis.
3. Rebleeding uncommon.

8. Drainage

Minor and modest hepatic in which satisfactory haemostasis obtained and no obvious biliary leak is present and do not require drainage. Closed suction drains are indicated in major hepatic lacerations requiring hepatotomy or resectional debridement. Posterior 12th rib resection may be justified in presence of coagulopathy, persistent oozing or expected biliary leak.

CURRENT APPROACH TO HEPATIC INJURIES

Current approach to hepatic injuries are

1. Extension of pringle time (>60 minutes)
2. Hepatotomy with selection vascular ligation in preference to crushing matterss sutures.
3. Intra abdominal abscess. Patients at the highest risk developing abscess are
 - a. Those with continued haemorrhage
 - b. When there is concomitant colonic injury
 - c. When open drainage is established.

Percutaneous drainage is attempted through the flank first, when it is not successful reoperation should be performed.

4. **Biliary Fistula**

It is common in patients who have had major hepatic resection, resectional debridement or after the performance of deep hepatotomy. In the absence of distal obstruction almost all biliary fistulae close with in 6 weeks. If majot disruption of a large intra hepatic duct present resection of the involved lobe or an intra hepatic roux-en-y hepatodochojejunostomy should be considered.

5. **Hyperpyrexia**

Major etiology remains unclear. Probable etiology is absorption of devitalized parenchyma. It usually resolves in 3-5 days after operation.

Mortality

Mortality rate ranges from 10-15%. About 80% were due to shock or transfusion coagulopathy.

PANCREATIC INJURIES

Plain X-ray abdomen is usually not contributory. CT Scan is an excellent technique because pancreas is an retroperitoneal structure. It is possible to distinguish between the mild traumatic pancreatitis causing diffuse swelling of the gland and transection of the pancreas. Thickening of the left anterior renal fascia has been noted in many patients. ERCP done by an experienced person may be a useful diagnostic modality if CT scan is or not available. It is rapidly performed and clearly documents the presence and location of a transected pancreatic duct.

TREATMENT

Classification of pancreatic injuries is given in Table-4

Control of active haemorrhage is necessary before evaluation of pancreas. The choice of surgery depends on

1. Time elapsed since injury
2. Haemodynamic status
3. Presence and absence of ductal injury
4. Presence and absence of concomitant duodenal injuries.

TABLE 4
CLASSIFICATION OF PANCREATIC INJURIES

TYPE	DEFINITIONS
I	Contusion and laceration
II	Distal transection or parenchymal injury with duct injury
III	Proximal transection or parenchymal injury with probable duct injury
...	...

All patients with injury to pancreas will need to have the entire pancreas visualized. The anterior and posterior aspects of head and neck are best seen by performing extensive Kocher's manouver.

The anterior aspect of body and tail is easily visualized by division of the gastrocolic omentum. The posterior aspect of the body visualized by dividing the retroperitoneum inferior to the pancreas

The various surgical procedures are.

1. Drainage

Drainage is routinely-performed procedure for all pancreatic injuries. Now there has been a tendency not to drain the minor injuries as postoperative pancreatic fistulae are extremely rare.

2. Pancreatorrhaphy with or without omental plug

Over sewing the edges of the pancreatic laceration has some appeal for control of haemorrhage. One alternative is to sew a viable portion of omentum directly into the laceration after confirming that there is no major pancreatic duct injury. Omentum will absorb small pancreatic leak eliminates the problem of necrosis.

For patients with ductal transection in the neck, body or tail of the pancreas the treatment options are

1. Distal pancreatectomy
2. Roux-en-y distal pancreaticojejunostomy.

In patients with ductal transactions in the head, the treatment options are

1. Roux-en-y distal pancreatico jejunostomy
2. Anterior Roux-en-y distal pancreatico jejunostomy.
3. Resection.

Anterior Roux-en-y pancreaticojejunostomy

It is indicated in rare occasion of injury in the head of the pancreas that completely transect the pancreatic duct but leave the parenchyma intact posterior to the duct. In these patients roux-en-y limb can be sewn in an end to side fashion. It is a technically demanding surgery and post operative leaks are common.

Resection

Resection of the head of the pancreas is indicated in

1. Patients with duodenal injuries
2. Total maceration of head of pancreas
3. Multiple perforations in the head of the pancreas.
4. Destruction of ampulla of vater.

The obvious sign of an injury to pancreatic duct is continuous flow of clear pancreatic juice in the area of laceration or perforation and presence of extensive fat necrosis. Intra operative pancreaticography can delineate the duct.

Distal Pancreatectomy

It is indicated in transactions of pancreatic duct that occur to the left of the mesenteric vessels. The extent of resection in these patients is usually 50-60% of pancreas. It is better to do splenectomy by dividing splenic vessels 1-2cms proximal to the pancreatic ductal transection. The distal end of the remaining pancreas is closed by fishmouthing and suturing of the anterior and posterior lips. Spleen can be preserved in patients who are haemodynamically stable.

Roux-en-y Distal pancreaticojejunostomy

It is indicated in patients in whom ductal transection is to the right of the mesenteric vessels. Distal pancreas is preserved because the post operative left subphrenic abscess will be significant and hyperglycemia will result in certain percentage of patients who underwent pancreatic resection.

Complications

The common complications are

1. Lesser sac or left subphrenic abscess
2. Pancreatic fistula
3. Pseudocysts of pancreas.

The mortality ranges from 17 to 19%

RENAL INJURIES

The following investigations to be taken to find out renal injuries in suspected cases.

1. Chest and abdominal radiographs are taken whenever possible.

Plain X-ray abdomen KUBU will show.

- a. Absent psoas muscle shadow
- b. Altered kidney outline
- c. Ground glass appearance suggestive of either extravasation of urine or haemoperitoneum.
- d. Associated bony injuries like rib fractures.

2. **Intravenous Urography**

High dose infusion pyelogram or double dose bolus pyelogram is used because standard low dose pyelogram has a false negative rate of approximately 34% in renal trauma. In IVU renal injury is suggested by

- a. Delay in visualization of the contract.
- b. Extravasation of the contract
- c. Lack of continuous renal outline
- d. Enlarged renal shadow.

A normal IVU in a patient with haematuria indicates minor renal contusion.

3. **Renal Scans**

it is more specific in diagnosis of injury to renal parenchyma, renal pedicle and renal pelvis. The advantages are it will neither exacerbate haemodynamic instability nor precipitate acute failure. Pedicle injuries or segmental injuries are diagnosed by lack of tracer flow to the kidney or to a part of it.

4. **Ultrasonography**

It is of limited value in initial evaluation of renal trauma because of imprecision and lack of functional correlation. It is useful in identifying and following perinephric and sub capsular haematoma and urinoma.

5. **CT SCAN**

It is a useful investigation in renal injuries. It identifies urinary extravasation more often than does pyelography and more precisely defines the extent of injury. It is more useful in non-operation management of renal traumas. It can delineate the intra renal haematoma, perinephric haematoma, renal lacerations with urine extravasation. Contrast CT Scan is more useful.

ANGIOGRAPHY

Non visualization of the kidney in pyelography requires immediate arteriography whenever possible. Renal artery intimal tear is the most common cause of non-visualization although severe contusion and renal spasms were less common cause. It is also more useful in assessing aortic and major visceral non-renal trauma especially hepatic and splenic injuries.

TREATMENT

Classification of renal injuries is shown in Table-5.

TABLE 5
CLASSIFICATION OF RENAL INJURIES

I	CONTUSION : Includes minor cortical laceration and subcapsular haematoma
II	LACERATION : Usually extends to the parenchyma of kidney
III	FRACTURES : Involves multiple portion of the kidney in which segments of parenchyma are not in continuity
IV	PEDICLE INJURIES : Usually occurs following deceleration type injury, rarely with blunt trauma

The management of blunt renal trauma depends upon the degree of injury. Great majority of the patients have minor parenchymal injury and are best treated by observation. Approximately 10% of the patients have class III injuries and uniformly require exploration to control haemorrhage and to have any chance of renal salvage. These injuries frequently require nephrectomy owing to extensive parenchymal injuries and other life threatening non-renal injuries.

The management of class II injuries is controversial. Operative management is indicated in persistent haematuria. Renal injuries, pedicle injuries and renal pelvic injuries usually require surgical treatment. Transperitoneal approach is generally preferred. Kidney is reached by incising posterior peritoneum from ligament of treitz to caecum. Repaired control of the pedicle without opening the Gerota's fascia is the most important surgical principle because initial exploration has the risk of sudden uncontrolled haemorrhage requiring nephrectomy.

Multiple renal arteries are present in 25% of the patients and should be suspected whenever the identified renal artery is smaller than anticipated. renal artery is secured with vascular clamps. In renal injuries traumatized renal parenchyma is debrided by incising with blade and sutured with chromic catgut. Intraparenchymal vessels usually requires ligation.

Shattered kidney is treated with nephrectomy to prevent haemorrhage. Renal vein injury is repaired by venorrhaphy. Renal artery injury is repaired by lateral arteriorrhaphy, arterial resection, repair by primary reanastomosis and by pass graft with saphenous vein etc. the collecting system should be repaired with 000 or 0000 chromic catgut.

INTERVENTIONAL RADIOLOGY

Percutaneous drainage affords initial treatment, often definitive treatment of both urinoma and infected haematoma. Delayed haemorrhage from segmental artery injury, false aneurysm formation can be treated by specific embolisation of affected branch vessels with gel foam or steel coil.

COMPLICATIONS

The common complication are

1. Urinoma
2. Abscess
3. Hypertension

abscess and urinoma may be heralded by pain, fever and flank mass. It is detected by sonography or CT Scan. Hypertension resolves over 2 to 6 weeks in most of the cases. It is caused by renal artery stenosis producing excess rennin.

MORTALITY

Depending on the associated injuries maximum mortality was detected in 12-40% of renal pedicle injuries. Death is usually associated with non-renal injuries.

MATERIALS AND METHODS

Forty-Five cases of blunt abdominal trauma with solid organ injuries admitted in all surgical units at Thanjavur Medical College Hospital, Thanjavur during the period of July 2003 to November 2005 were taken for this study.

The cases were selected in such a way that only those patients with definitive history and clinical findings suggestive of injury to solid organs which were later confirmed by investigations and/ or laparotomy/ autopsy.

Detailed history regarding the mode and nature of injury were taken, time elapsed between the time of injury to the time of admission in the hospital and the time of injury to the time of operation were analysed. The clinical features were studied in detail with special note to any associated injuries like head injury, chest injury and fracture limbs. Basic investigations viz. blood Hb, blood urea, blood sugar, serum creatinine and blood grouping were done in all cases. Plain X-ray of the abdomen in erect posture was taken in most of the cases except in those who were admitted in a critically ill condition. Radiographs of other parts were also taken to find out associated injuries.

Under aseptic precaution using sterile 18 G needle peritoneal tapping done in all the four quadrants, in all patients with the history of blunt abdominal trauma.

In patients with negative results diagnostic peritoneal lavage was done. DPL was done by semi open technique. Under local anaesthesia a subumbilical incision was made and carried down to the linea alba. Peritoneal dialysis cathater was penetrated through the peritoneum. Stylet was withdrawn and cathater was directed at a 45 angle into the pelvis. Of 10 ml of non-clotted blood is not withdrawn then one litre of ringer lactate solution is infused into the abdomen and then the empty bottle is placed on the floor allowing the intraperitoneal fluid to shiphon back and the analysis of the fluid is done. Ultrasonogram of abdomen, intravenous urogram and CT Scan abdomen were done in relevant cases. Serum amylase was taken in a selected group of patients.

The cases once received in the admitting ward after confirming the intraabdominal pathology were prepared for emergency laparotomy expect when conservation management was planned. Preoperative blood transfusions were given whenever necessary.

At laparotomy a systematic approach with examination of all intraabdominal organs were made. After surgery the patients were continued on nasogastric, aspiration, intravenous fluids, combination of antibiotics involving ampicillin, Genetamycin and Metronidazole. Postoperative complications were specifically looked for, if present were treated appropriately.

OBSERVATION

In our study of forty-five patients, solid organ injuries were confirmed preoperatively in thirty-four patients, by ultrasonogram in nine patients and by postmortem finding after death in two patients.

In this study the following injuries were noted. Total number of splenic injuries was twenty-two. Number of isolated splenic injuries was fourteen and associated with other organ injuries was eight.

Total number of liver injuries was fourteen. Number of isolated hepatic injuries was seven and associated with other injury was seven.

Total number of renal injuries was thirteen. Number of isolated renal injuries was nine associated with other organ injuries was four. Among the thirteen cases left kidney was involved in seven cases and right kidney was involved in six cases.

Total number of pancreatic injuries was six. Isolated pancreatic injury was one and associated with other organ injuries was five.

Among the six cases pancreatic body was involved in four cases and tail was involved in two cases.

Injury due to road traffic accidents was the cause in twenty-five cases, injury during agricultural activities was fourteen and injury due to fall from height was the cause in six cases. Among the twenty five road traffic accidents, sixteen patients sustained injury due to direct hit, four patients due to run over by vehicles, another three was thrown out of the vehicle which caused blunt injury and the rest two was due to vehicle capsize over the patients.

SPLENIC INJURIES

Spleen is the commonest organ injured following blunt abdominal injury. Our study showed a total of twenty-two cases of splenic injuries. Among these isolated splenic injury was fourteen and associated with other organ injury was eight. Twenty-one cases underwent laparotomy after resuscitation. The procedures include nineteen splenectomies and two splenorrhaphies and the mortality was five.

The mode of injury in these patients were different. Thirteen patients for injured in road traffic accidents. Six of these were injured during agricultural work. Three patients were injured due to fall from height. Among the thirteen road traffic accidents, direct hit was the commonest mode of injury accounted for nine cases.

The time interval from injury to the admission in hospital was varying from one hour to thirty hours. The injury operation interval ranges from four hours to thirty-six hours. The delay in surgery was due to non-specific presentation on admission.

At the time of injury patients were suspected to have splenic injury with history of injury over left hypochondrium. Fourteen patients were haemodynamically unstable on admission and they were resuscitated with IV fluids and blood and operated.

The commonest finding in all the patients were tenderness in the left hypochondrium. Most of the patients had contusions or abrasions over the left hypochondrium. Abdominal distension was present in ten patients. Rigidity and localized guarding of the abdomen were present in ten patients. Kehr's sign was positive in six patients. Balance sign was demonstrated in none of these patients.

Bowel sounds were absent in eleven patients. Perrectal examination showed buldge in the rectovesical pouch in nine patients.

Abdominal paracentesis was done in all patients and was positive in twenty cases. DPL was done in two patient which showed positive results.

Plain X-ray abdomen erect view and X-ray chest AP view were taken in all patients. Two patients X-ray showed fracture 6th to 9th ribs on the left side. In three patients there was a fracture in the 9th rib on the left side. Three patients X-ray showed air under right dome of diaphragm. Fracture left clavicle was found in one patient. Four patients X-rays were suggestion of peritonitis. Ultrasonogram was done in two patients, which showed splenic haematoma.

One forty years old male admitted with history of road traffic accident in a haemodynamically unstable condition.

X-ray abdomen and chest showed fracture 6-9th rib on the left side. Paracentesis was positive. This patient expired within one hour of admission due to associated head injury. The postmortem findings showed Grade III injury spleen with retroperitoneal haematoma.

The diagnosis of splenic injury was confirmed by clinical examination, the presence of haemoperitoneum which was confirmed by abdominal paracentesis and ultrasonogram. All the twentyone patients underwent laparotomy. Two patients had Grade II injury, nine patients had Grade III injury, six patients had Grade IV injury and four patients had Grade V injury.

Laparotomy showed thirteen isolated splenic injuries and eight splenic injuries with associated other organ injuries.

Retroperitoneal haematoma were found in eleven patients. Nineteen patients underwent splenectomy. Two patients who were haemodynamically stable showed Grade II lacerations in the diaphragmatic surface of spleen. There was mild bleeding from the splenic laceration. The laceration was sutured with 00 chromic catgut over gel foam and the bleeding was arrested. There is no postoperative morbidity in those patients. For the rest of eleven patients with isolated splenic injury splenectomy was done. For patients with

splenic injury associated with other organ injuries, splenectomy was done for splenic injury and appropriate surgical procedures were done for the associated organ injuries.

All the patients operated were treated with combination of antibiotics including Ampicillin, Gentamycin and metronidazole. Post operative period was uneventful in ten patients and three patients developed postoperative fever. Ultrasonogram showed no intraperitoneal collections and the fever subsided with antibiotics. One patient developed wound gaping, which was secondarily sutured.

Five patients expired postoperatively. In three patients the death was due to multiple organ injuries and associated duodenal injury and fracture pelvis. In another patient the death was due to delayed admission in the hospital with Grade IV lacerations. The three splenectomized paediatric patients were advised to have pneumococcal vaccine.

Liver Injuries

Next to spleen, liver is the commonest organ to get injured following blunt abdominal trauma. In our study the incidence of liver injury is fourteen. Isolated liver injury was found in seven patients and associated with other organ injury was seven. Twelve cases were operated. The mortality was four.

Among the fourteen patients, nine patients were injured in road traffic accidents and direct hit was the mode of injury in seven cases. Bullock cart is responsible for injury in three cases which occurred during agricultural work. Two patients were injured due to fall from height. The injury admission interval varies from two hours to thirty-eight hours. The injury operation interval ranges

from four hours to forty hours. The delay in operation was due to delay in the admission of the patient.

Tenderness was guarding were present in all the patients. Contusions and abrasions were present in ten patients, which were more marked in the right hypochondrium. Eleven patients presented with abdominal distension. Bowel sounds were normally heard in ten patients. Per rectal examination showed bulge in the rectovesical pouch in six patients. Abdominal paracentesis was done in all cases, positive results obtained in twelve cases negative in two cases. DPL was done in these two cases which showed positive result in one and negative result in one case.

Plain X-ray abdomen erect posture was taken in all patients. Seven patients showed fracture ribs on the right side. Three patients showed air under right dome of diaphragm suggestive of associated hollow viscus injury. One patient showed fracture right scapula. Features of peritonitis was present in seven patients.

In this study one patient who sustained blunt injury abdomen in road traffic accident, reported five hours after injury with abdomen clinically normal except mild tenderness in the right hypochondrium. Abdominal paracentesis and DPL were negative. Ultrasonogram showed lacerations measuring 2.9x1.cm in the posteroinferior aspect of right lobe of liver with minimal fluid in the pelvic cavity. Since the patient was haemodynamically stable he was conservatively treated. Repeat ultrasonogram done four days later showed right pleural effusion with hypoechoic area measuring 3 x1.5 cm in the right lobe of liver. Hospital stay was otherwise uneventful in this patient.

In the other patients in whom DPL was positive. Ultrasonogram showed injury in the posterosuperior aspect of right lobe of liver measuring 4x2cms. Eleven patients were haemodynamically unstable.

All these twelve patients were taken up for surgery. On laparotomy five patients were found to have Grade II injuries, three patients with Grade III injuries and four patients with Grade IV injuries.

Some hepatorrhaphy with 00 vicryl over gel foam was done in five patients with Grade II injuries, in three patients with Grade III injuries and two patients with Grade IV injuries. One of the patients with Grade III injury was associated with tear in the first part of duodenum which was closed with 00 chromic catgut and for this patient Devine's pyloric exclusion procedure along with anterior gastrojejunostomy was done.

Patient recovered well except postoperative fever and the fever subsided within a week. Another patient with Grade IV injury was treated by resectional debridement of the devitalized portion of the liver by finger fracture technique. Omental pack was placed over the defect in the liver and the peritoneal cavity was drained. Patient expired on the first postoperative day due to associated chest injuries.

Another patient Grade IV injury was treated by perihepatic packing with laparotomy pads. Patient developed biliary leak and expired on the second postoperative day due to associated chest injury.

Postoperatively one patient with Grade II injury developed postoperative adhesive obstruction which was treated conservatively. Another patient developed abscess in the right sub diaphragmatic space and was aspirated with ultrasonographic guidance. Postoperative fever was present in

six cases. Two patients developed pleural effusion postoperatively. One patient was conservatively managed and in the other patient 300 ml of hemorrhagic fluid was aspirated. Both the patients recovered well.

RENAL INJURIES

Among the thirteen cases of renal injuries studied, nine cases were with isolated renal injuries and four cases with other associated organ injuries. Eleven cases were treated conservatively.

Among the thirteen patients with renal injuries six sustained injury following road traffic accidents, five patients sustained injury during agricultural work and two patient sustained injury due to fall from height. The injury admission interval varies from one hour to thirty two hours.

Twenty four years aged man was admitted with history of road traffic accidents an hour after the injury. Patient had macroscopic haematuria and was haemodynamically stable. Abdomen was clinically normal except for mild tenderness in the left loin. Abdominal paracentesis and DPL were negative , Plain X – ray abdomen was not contributory. Ultra sonogram showed absent right kidney with perinephric haematoma around the left kidney. Intravenous urogram showed non visualization of right kidney with extravasations of dye on the left side.

Patient was put on conservative line of treatment. Patient developed urinoma and renal failure in the recovery period. The urinoma was drained through a left loin incision. Dialysis was given in the postoperative period. Patient recovered completely after 45 days.

Sixteen years age male patient admitted with history of road traffic accident eight hours after the accident. Patient had hypovolemia, tenderness and guarding over the abdomen. Bowel sounds were normally heard. Urine analysis showed microscopic haematuria. Abdominal paracentesis revealed haemoperitoneum. On laparotomy Grade IV liver lacerations was found with Grade I injury was left undisturbed . Urine analysis after two weeks showed only 2-3 RBCs.

Two other patients with history of road traffic accidents were admitted in a haemodynamically unstable state. Rigidity and guarding were present. In one patient abdominal paracentesis and DPL were negative. Urine – analysis shows macroscopic haematuria. Ultrasonogram and CT scan showed Grade III left renal injury with an associated left side haemothorax. Intravenous Urogram shows extravasations of contrast on the left side. Laparotomy was done for this patient. There is Grade III lacerations in the left kidney. Nephrectomy was done on the left side. Intercostal drainage was done for the haemothorax. In the other patient, abdominal paracentesis showed positive results. This patient expired before surgery within an hour of admission due to associated liver injury, head injury and chest injury.

Another six patients were admitted with a different histories of injury in a stable condition . The abdomen was clinically normal except mild tenderness in the renal angle. Ultrasonogram and CT showed perinephric contusion on right side in two patients and on left side in four patients. Intravenous urogram showed normal excretion of contrast on the both sides

without extravasation of contrast. These patient were put on conservative line of management. All these patient recovered well with out morbidity.

Two other patients admitted following injury while doing agricultural work. Both the patient were unstable on admission. Paracentesis was positive in both the patient. After resuscitation laparotomy and done. One patient showed Grade III injury to spleen with Grade II injury left kidney. For this patient splenectomy was done. The renal injury left undisturbed. The other patient showed Grade II injury liver with Grade I injury right kidney. Hepatorrhaphy was done and the renal injury left undisturbed. Both the patient recovered well.

Another patient admitted following injury due to fall from height . USG showed Grade II renal injury with mild extravasation of contrast on IVP. This patient also put on conservative line of treatment. There is no morbidity in this patient.

In our study of thirteen cases of renal injury, the mortally is one. Mortality is mainly due to other associated injuries and not due to renal injury. All the patients those who are treated conservatively are put on strict bed rest with adequate hydration for a period of three weeks. Urine analysis done after three weeks showed only 2-3 RBCs and the renal para metres are also with normal limits.

PANCREATIC INJURIES

Total pancreatic injury in our study is six. Among these isolated pancreatic injury is found in one case and five cases with associated organ injuries. Total number of cases operated was six and the mortality was two,

Two patient had injuries following road traffic accidents. Three patients injured while doing agricultural work and another one from injury due to fall from height. The injury admission interval ranges from four hours to thrity hours. All the patients were haemodynamically unstable on admission.

Pancreatic injury cases had various modes of presentation. A 18 years aged male was admitted with a history of road traffic accident. Patient admitted four hours after the injury with hyptension, abdominal distension, guarding and rigidity. Bowel sounds were not heared. Plain X-ray abdomen was not contributory. Abdominal paracentesis was done. Altered blood mixed with intestinal contents were aspirated. Laparotomy was done after resuscitation. About two litres of blood mixed with intestinal contents were aspirated. There was a lacerated injury in the first part of duodenum along with Grade III injury of spleen. Pancreas was transected completely in the body about 6 cm from the C-loop of the duodenum.

Distal pancreartectomy along with splenectomy was done. Lacerations in the duodenum was closed with oo vicryl. A gastronomy was made and through which Devin's pyloric exclusion was done and the gastrotomy wound was used for gastrojejunal anatomists. The patient was treated with

cefotaxime, gentamycin and metronidazole. Serum amylase was done and it was raised to 900 IU. The blood sugar was normal. This patient expired on the seventh postoperative day due to intra abdominal sepsis.

Another thirty years old female was admitted with the history of kick by a bull. Patient was admitted in the hospital thirty hours after the injury with hypovolemic shock and the abdomen was soft with severe tenderness over the epigastrium. Bowel sounds were heard. Free fluid was present. X-ray abdomen was not contributory. Abdominal paracentesis revealed haemoperitoneum. Laparotomy was done after resuscitation. There was Grade V lacerations in the spleen. Complete transection of the body of pancreas was present.

Distal pancreatectomy with splenectomy was done. Postoperatively patient developed fever and hyperglycemia. The blood sugar level was 210 mg % on the third post operative day. Daily blood sugar was monitored. Serum electrolytes were within normal limits. Serum amylase was raised to 820 IU/ml in the fourth postoperative day without antihyperglycemic drugs.

Two other patients one with history of fall from height and other with history of road traffic accident were admitted. The injury admission interval were five and eight hours respectively. Both the patient showed mild abdominal tenderness. There was mild abdominal distension present. Bowel sounds were present in both cases. Abdominal paracentesis of both the

cases revealed haemoperitoneum. Laparotomy was done for both the patients.

In one patient laparotomy revealed Grade IV laceration of spleen with haematoma over the tail of the pancreas. The haematoma was left undisturbed and splenectomy was done. The patient had uneventful postoperative period.

In another patient there was lacerations in the tail of pancreas with mild oozing. There is no evidence of pancreatic duct injury, hence simple closure with drainage tube in the lesser sac was done. There is mild elevation of serum amylase to 500 IU/lit, which after two weeks returned to 225IU/lit. There was no morbidity in the postoperative period.

Two other patients sustained blunt injury to the abdomen while doing agricultural work. One got injured due to fall from bullock cart. The patient was haemodynamically unstable. X-ray abdomen erect posture in both. Laparotomy revealed Grade II injury to the body of pancreas in both the patient with tear in the small intestine. Distal pancreatectomy along with closure of the small intestinal tear was done. One patient expired in the 9th postoperative day due to electrolyte imbalance following pancreatic fistula. The other patient developed intraabdominal abscess. The patient was followed up with antibiotic and serial ultrasonogram. Two patient recovered well without any intervention.

In this study of six cases of pancreatic injury serum amylase was increased in five cases, suggesting raised serum amylase is an indicator of pancreatic injury.

DISCUSSION

The present study included observations made in forty-five cases admitted with the history of blunt trauma with solid organ injuries. This constitutes 0.058% of total hospital admission from July 2003 to November 2005.

Thirty-six cases were in the age group of 15-45 years which accounts for 80 % of cases. Five cases were under the age of 15 years of age and four cases were over fortyfive years of age. S.C Dwivedi **et al** and B.C. Jain **et al** (1993) reported similar results. This shows that persons in the active period of life are more susceptible for accidents and injuries. Forty-one patients were males accounting for 91 % and only four were females accounting for 9 %. B.C. Jain **et al**(1993) and Connecticut society of surgeons study on abdominal trauma reported similar results. This increased incidence in males is probably due to outdoor nature of occupation and aggressive behaviour in males. The age incidence in our study is shown in Table 6.

In our study the commonest mode of injury was the road traffic accidents which occurred in twenty-five cases accounting for 55.5 % followed by injuries due to agricultural and agricultural related works in fourteen cases accounting for 31 %. This higher incidence is due to the more agricultural activities in this region. The other mode of injuries are due to fall from height account for 13 % of cases. The relative occurrence of mode of blunt injuries is shown in Table 7. S.C. Dwivedi et al reported 57 % incidence of motor vehicular accidents in blunt abdominal trauma. These are slightly lower than that of reports of Denver. General Hospital 1990 which states that motor vehicle accidents accounts for 75 % of cases. This may be due to higher

vehicular traffic in developed countries. The mode of injuries in road traffic accidents in relation to number of organ involvement is shown in Table 8.

Solid organs are injured by a direct violence or deceleration injury because of the protected position and ligament attachments. Injury to the kidney may occur by a contrecoup mechanism or direct trauma. Pancreas is usually injured by direct trauma. In our study direct hit was the commonest mode of injury occurred during road traffic accidents. But the mortality is more in run over accidents when compared to direct hit.

In our study thirtyfour patients were admitted in this hospital within 10 hours after injury. The mortality in this group was six accounting for 13.3 % and eleven patients were admitted after ten hours of which mortality occurred in three patients. This is because delay in admission with massive haemorrhage leading to irreversible shock and peritonitis. This is similar to reports by S.C. Dwivedi **et al.**

Twenty seven patients were haemodynamically unstable and shock was evident on admission. In Connecticut society of surgeons study 44 % of patients were in shock at the time of admission.

Treatment in the form of resuscitation or surgery was instituted to all patients immediately after admission. Delay in operation in some patients was due to ignorance on the part of the patient and their relatives about the severity of injury and non availability of conveyance to the hospital.

TABLE 8
MODE OF INJURY IN RTA VS NUMBER OF ORGAN INVOLVEMENT

SL. No	MODE OF INJURY	NO OF CASES	NO. OF ORGANS INVOLVED			MORTALITY
			ONE	TWO	THREE	
1	Direct hit	16	11	4	1	37.5%
2	Run Over	4	2	1	1	50%
3	Thrown out of vehicle	3	3	-	-	0%
4	Vehicle capsize	2	2	-	-	0%

TABLE – 9
PHYSICAL SIGNS

SL. NO	PHYSICAL SIGNS	OVER STUDY		DAVIS et al	DWIVEDI Et al
		NUMBER	PERCENTAGE		
1	Tenderness	33	73.3%	75 %	91 %
2	Rigidity	24	53.3%	28 %	71%
3	PR Exam Positive	14	31.1%	3 %	-
4	Bowel sounds	29	64.4%	-	60%

Preoperative physical examination showed that thirtythree patients had abdominal tenderness and guarding. Rigidity and rebound tenderness were present in twenty four patients accounting for 53.3 % . Bowel sounds were heard in twentynine patients accounting for 64.4 %. Perrectal examination showed collection in the rectovesical pouch in fourteen patients. Davis **et al** in 1976 reported that abdominal pain occurred in 75% rigidity and rebound tenderness in 28 % of patients. In his study 45 % had neither complaints nor signs of intra abdominal injury, of which 44 % were ultimately explored and 77 % of them had a documented injury requiring repair. The comparative figure of our study and the studies conducted by Davis et al and Dwivedi **et al** are given in Table 9.

The commonest associated injury in our study is chest injury which accounted for ten cases followed by injury to extremities and head injury. The comparative figures of our study and **B.L. Jain et al** are given in Table 10.

Laboratory investigations are of limited value immediately following blunt trauma. Evidence of intra abdominal injury in plain X-ray was present in twenty three patients in the form of fracture ribs in seventeen patients and air under diaphragm in six patients. There is a 20 % chance of splenic injury and 10 % chance of liver injury with fracture ribs on the left or right lower six ribs (**Graffin W.o et al 1978**, **Moore E.E. 1985**) . But time should not be wasted and a trained person should supervise, as the abandonment of the patient in the radiology department even for a brief period can have disastrous consequences.

Abdominal paracentesis when positive is highly predictive of significant intraabdominal injuries but the accuracy varies from 50 % to 90 % in various studies, **Anthony et al (1966)** Showed 90 % accuracy. The false negative rate is very high ranging upto 36 % to 40 % (**Powel 1982**, **Root et al 1965**). In our study abdominal paracentesis was positive in thirty two patients accounting for 71.1 %. Negative in thirteen patients constituting false negative in 28.8 % of cases.

In many large reviews DPL is shown to have 95 % sensitivity, specificity of 98 % to 99 % and accuracy of 97 % (**Fisher R.P. et al 1978**, **Soderstorm. C.A. 1986**) . In our study DPL was done in thirteen cases. Negative results were obtained in ten patients of which nine patients were found to have renal injuries and another one had liver injury. This shown the limitations of DPL in detecting retro peritoneal injuries.

Ultrasonography can be used routinely in emergency department and it can demonstrate the presence of three fluid and solid organ injuries (Furtschegger **et al 1988**). In our study ultrasonogram was done in thirteen haemodynamically stable patients. In twelve cases it clearly demonstrated the injury. In one case with minor renal injury no abnormality was noted.

Out of these thirteen cases DPL was done as mentioned above it showed positive result in three cases. This shows ultrasonogram is complimentary to clinical examination and paracentesis. Stritmatter B. 1988 showed a sensitivity of 95.5 % and specificity of 97.5 % hence ultrasonogram can be used as a initial imaging procedure.

Erik Kisa M.D. **et al in 1986** reported that emergency IVP is useful in patients with specific indication and gross haematuria and patients with microscopic haematuria alone may be safely followed by observation. In our study six patients with macroscopic haematuria were submitted for IVP. In three patients IVP showed evidence of renal injury. IVP was also useful to confirm the presence of other monthly functioning kidney.

Computerized Topography is the best investigation of both solid and hollow abdominal viscera. With careful interpretation even subtle visceral, bowel and mesenteric injuries can be detected (department of radiology, Virginia Health science). CT scan has specificity and sensitivity of more than 95 %. Intraperitoneal fluid tends to accumulate in the Pouch of Douglas (67%) and Morison's Pouch (30 %) . In our study nine cases of renal injuries were submitted for contrast CT scan. In one patient there was absent right kidney with extravasations of contrast in the left kidney and in the other six patients

CT scan showed perinephric contusion in the kidney. Two patients showed extravasation of contrast indicating Grade II renal injury.

TABLE – 10
ASSOCIATED INJURIES

SL. NO	ASSOCIATED INJURY	OUR STUDY		B.L. JAIN et al
		NUMBER	PERCENTAGE	
1	CHEST INJURY	10	22.2 %	11%
2	HEAD AND NECK INJURY	6	13.3%	10%
3	EXTREMITIES	7	15.5%	16%
4	PELVIS FRACTURE	1	2.2%	2%

TABLE – 11
ORGAN INVOLVEMENT

SL. NO	ORGANS INVOLVED	OUR STUDY		DENVER HOSPITAL STUDY	HERMAN HOSPITAL STUDY
		CASES	PERCENT		
1	SPLEEN	22	48.8%	46 %	57.2%
2	LIVER	14	31.1%	33%	46.6%
3	KIDNEY	13	28.8%	-	9,5%
4	PANCREAS	6	13.3%	9%	6%

The greatest problem in dealing with management of blunt abdominal trauma is early diagnosis. This is usually due to making of abdominal findings by associated injuries. When the diagnosis is in doubt especially in a hospital where sophisticated investigations are lacking, one must often depend upon repeated physical examination done at frequent intervals to decide whether the patient required laparotomy or not. (P> Sivalingam **et al 1982)**

At laparotomy the commonest organ injured in most of the series is spleen (Denver Hospital study, Herman Hospital 1983). In our study also the commonest organ involved is spleen followed by liver. The organs involved in our study are shown in Table 11.

In cases of injured due to fall from height, the number of organs involved increases as the height increases. In our study of six cases of fall from height in four cases the height was below twenty feet and this caused single organ injury. Where as in two cases the height of fall was more than twenty feet and this caused multiple organ injuries. But no mortality was noted in all those six patients. Number of organs involved in relation to height was shown in table 12.

TABLE – 12**NO. OF ORGANS INVOLVED IN RELATION TO HEIGHT**

SL. NO	HEIGHT IN FEET	NO OF CASES	NO. OF ORGANS INVOLVED		NO. OF ASSOCIATED INJURED	MORTALITY %
			ONE	TWO		
1	<10	1	1	-	0	0
2	11-20	3	3	-	2	0
3	>20	2	-	2	1	0

TABLE – 13**DISTRIBUTION OF POTTER ORGAN INVOLVEMENT IN BLUNT****ABDOMINAL TRAUMA**

SL. NO	ORGANS	TOTAL NUMBER OF CASES INJURED	ISOLATED INJURY	ASOCIATED WITH OTHER ORGAN INJURIES	
				Number	Organs involved
1	SPLEEN	22	14	8	Liver – 3 Pancreas – 3 Kidney – 3 Duodenum – 1 Intestine - 2
2	LIVER	14	7	7	Spleen – 3 Kidney – 3 Duodenum – 1 Ileum - 1
3	KIDNEY	13	9	4	Liver – 3 Spleen – 1
4	PANCREAS	6	1	5	Spleen – 3 Duodenum – 1 Intestine - 2

SPLenic INJURIES

In our study splenic injury is responsible for twenty two cases and the commonest mode of injury is road traffic accidents. Of the twenty two cases two cases were females. Potential signs were present in twelve cases and paracentesis was positive in twenty cases. Splenectomy was done in nineteen cases and splenorrhaphy was done in two patients. Peter Mucha 1986, recommends non-operative management in patients with haemodynamic stability, absent peritoneal signs and those requiring less than two units of blood with no other associated injury. In our study obvious indication for laparotomy was present in all cases and as there is lack of specialized investigations non operative management was attempted in none of these patients.

Splenorrhaphy is indicated in patients with few intra abdominal injuries and a Grade 1-4 magnitude (maingot). In our series splenorrhaphy was done in two male patients because they were admitted in a haemodynamically stable condition and with no other associated injury. These patients were followed up with no morbidity. Complication occurred in only three patients. Two of them are due to other associated injuries, pancreatic injury in one and liver injury in the other. One patient had mild wound gaping. Mortality occurred in six patients. Four of them are due to other associated injuries. The commonest associated intra abdominal injury in our study is pancreas and liver. Distribution of other intra abdominal injury in our study is pancreas and liver. Distribution of other organ involvement in blunt abdominal trauma is shown in Table 13.

TABLE – 14
MANAGEMENT OF HEPATIC INJURIES

SL. NO	PROCEDURE DONE	NO OF CASES
1	NON OPERATIVE APPROACH	1
2	HEPATORRHAPHY	10
3	RESECENTIONAL DEBRIDEMENT WITH OMENTAL PACK	1
4	HEPATORRHAPHY WITH PERIHEPATIC PACKING	1

TABLE – 15
**INJURY DUE TO ROAD TRAFFIC ACCIDENTS VS AGRICULTURAL
WORK**

SL. NO	RTA	AGRICULTURAL AND RELATED ACTIVITIES	OTHERS	TOTAL
SPLEEN	13	6	3	22
LIVER	9	3	2	14
KIDNEY	6	5	2	12
PANCREAS	2	3	1	6

HEPATIC INJURIES

Liver injury occurred in fourteen cases. The most common mode of injury is road traffic accidents. Peritoneal signs were present in thirteen cases. The indication for non operative approach are patients who are haemodynamically stable and have no obvious indications for laparotomy (Sabiston). In our study a haemodynamically stable patient with absent peritoneal signs was admitted. Ultrasonogram showed minor laceration, minimal free fluid and no evidence of other significant injuries. He was put on conservative treatment and followed up with ultrasonogram. Patient developed minimal effusion in the right pleural cavity postoperatively and was treated conservatively.

Hepatorrhaphy was done over gel foam in ten cases and complex surgical repair was required in two cases. This was similar to study conducted by T.G. John **et al 1992**. In this study 70 % of cases required simple repairs 20 % required complex repairs and non-operative approach in 10 % of cases. The various procedures done in our hospital for hepatic injury patients are shown in table 14. Most of the complications are due to associated other organ injuries.

The commonest associated other intra abdominal organ injury is injury to spleen and injury to kidney which occurred in three cases each. T.G. John **et al** reported associated injury to spleen in 18 % of hepatic injury cases with blunt injury to abdomen. Mortality occurred in four cases and the mortality was due to associated injuries.

RENAL INJURIES

Thirteen cases of renal injuries were studied. Preoperative diagnosis was made in nine cases, macroscopic haematuria in seven cases and microscopic haematuria in five cases. Injury to the kidney in three cases was diagnosed during laparotomy for injury to other organs. In one case injury is found at the postmortem.

The commonest mode of injury was road traffic accident, which accounted for six out of thirteen cases. This is similar to Scott Yarbrow **et al** **1987**, who reported that 51 % of his cases were due to road traffic accidents .

But in our region incidence of injury occurring during agricultural work is increased due to the agricultural nature of this district, In this study about five case of renal injuries occurred during agricultural work, The constituents 38.4 % where as injury due to road traffic accidents is 46 % only. Comparison of injured due to road traffic accidents and unbury due to agricultural activities is given in table – 15.

Peritoneal sings were present in four cases and this was due to associated other organ injuries. The commonest associated intra abdominal organ injured was liver.

Only 10 % of patients with blunt abdominal trauma have major injuries and all of them require laparotomy. The management of minor injuries is mainly conservative (Campbell)

Scott yarbrow **et al** reported that out of 155 cases only nine cases required laparotomy and of which only one required nephrectomy. In our study IVP and USG showed non visualization of contralateral kidney in one patient because of congenital absence and he was treated conservatively.

TABLE – 16**NATURE OF AGRICULTURAL INJURIES AND ORGAN INVOLVEMENT**

TYPE OF INJURY	NO OF CASES	ORGANS INJURED
Bull gore injuries	4	Spleen – 2 Liver – 1 Pancreas – 1
Paddy Field Injuries	1	Pancreas – 1 Kidney – 1
Tractor accidents	2	Spleen – 1 Kidney - 2

TABLE – 17**ORGAN RELATED MORTALITY**

NUMBER OF ORGANS INVOLVED	TOTAL NUMBER OF CASES	DEATH	PERCENTAGE OF SURVIVORS
1	21	3	85.7%
2	12	4	66.6%
3	2	5	100 %

One patient expired due to associated other organ injured. One patient developed urinoma and followed by renal failure. On the 45th postoperative day he was recovered and discharged. All the patients were treated conservatively except one patient with Grade III left renal injury who underwent nephrectomy.

Pancreatic injuries

Pancreatic injuries occurred in six cases and all cases were associated with other intra abdominal organ injuries except one isolated pancreatic injury. Peritoneal signs were present in five cases. Elevation of serum amylase was found in four cases. Road traffic accidents was the cause in two cases and three cases sustained injury during agricultural work. One patient got injury

due to fall from height. In most of the cases injury to the pancreas was due to the result of an external force striking the abdomen and compressing the gland against the rigid vertebral column. (Baker **et al 1963**). In our study three such cases with injury to the body of the pancreas occurred. Analyse released is absorbed from interstitial spaces which is responsible for increased level found in serum soon after injury. The differeny types of agricultural related injuries and the organs involved is given the Table – 16.

Distal pancreayectomy was done in four cases. Simple repair with non absorbable suture material was done in a case with injury to the tail of Pancreas. Combined pancreaticoduodenal injury occurred in one case in whom Devine's pyloric exclusion with gastrojejunostomy was done. One patient with haematoma over all of Pancreas without ductal injury was treated conservatively. In two patients with Grade II injury to the body of pancreas distal pancreatectomy was done.

Complications are frequent following pancreatic injury. Pancreatic fistula is the commonest complication following pancreatic trauma. James T. Adams **et al 1996**, reported pancreatic fistula in four out of five cases of pancreatic injuries. In our study three patients developed pancreatic fistula which closed spontaneously in two patients and one patient expired on the 9th Postoperative day due to electrolyte imbalance. Aldis et al also reported that 80 % of the fistula closes spontaneously if there is no distal obstruction.

The next common complication is the formation of Pseudocyst (Aldis **et al 1946**). This occurred in none of the patients in our study. The other complication in our study is subphrenic abscess.

MORTALITY

Mortality occurred in nine cases and accounting for 20 %. Herman Hospital study showed a mortality of 24% of which 38.8 % was due to other intra abdominal organ injuries and 34.3% was due to head injuries.

The number of organs involved related morality in our study was shown in the Table 17.

This results shows that mortality increases as the number of organs involved increases. This is similar to the study conducted by Feliciano D.V. **et al 1988**. Road traffic accidents accounts for eight cases of death which shows that road traffic accidents produces multiple associated injuries. Out of eight cases of death two cases were due to associated head injuries, two cases were due to associated chest injuries and one case was due to associated head and chest injuries. Three cases were admitted more than ten hours after injury. Mortality related associated injuries is shown in Table 18.

TABLE – 18
MORTALITY DUE TO ASSOCIATED INJURIES

SL. NO	TYPE OF INJURY	NUMBER OF CASE
1	HEAD INJURY ONLY	2
2	CHEST INJURY ONLY	2
3	HEAD AND CHEST INJURIES	1
4	HEAD AND PELVIC INJURIES	1

CONCLUSION

1. The commonest cause of injury in our study is road traffic accidents accounting for 55.5 % of cases which is similar to other studies. Among the road traffic accidents direct hit accounts for 64% of cases followed by run over accidents with accounts for 16 %
2. Similar to many large series males are more often affected in blunt abdominal injuries than females and middle aged persons are more often affected than extremes of age
3. It has been shown in our study that the earlier the diagnosis of solid organ injury better is the prognosis. This is consistent with other studies
4. The commonest intra abdominal organ injured in our study is spleen followed by liver, kidney and pancreas.
5. It has been shown that in cases of fall from height if the height increases there is increased chances of multiple organ involvement
6. Commonest associated injuries occurred in our study was chest injury in ten cases followed by injury to the extremities in seven cases.
7. Thorough initial clinical evaluation, repeated clinical examinations monitoring vital signs are essential in minimizing the chance of missing life threatening intra abdominal injuries. As with other studies the biochemical investigations are not of much help. The investigations only complimentary to clinical diagnosis.

8. Whenever solid organ injuries are suspected, in the absence of specialized investigations especially in the night in a haemodynamically unstable patients, it is better to do laparotomy.
9. Splenic conservation procedures are better advocated for young individuals with minor injuries to avoid complications of splenectomy. But the patients must be followed up for any delayed complications.
10. Non operative approach to the minor liver injuries may be better policy in a haemodynamically stable patient whenever specialized investigations like ultrasonogram or CT scan is available but the patient should be sequentially examined and vital signs to be mentioned.
11. Injury occurred during agricultural and related activities is more in this region due to agricultural nature of this part of Tamil Nadu.
12. Morality is more in road traffic accidents because it causes multiple organ injuries. Run over accidents causes increased mortality when compared to direct injuries.
13. The mortality is more in patients with other associated injuries especially head injuries and in patients who were admitted delayed in the hospital.

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TABLE 1

CRITERIA FOR EVALUATION OF PERITONEAL LAVAGE FLUID

POSITIVE : 20 Ml gross blood on free aspiration (10 ml in children)
Greater than or equal to 1,00,000 RBC/CC
Greater than or equal to 500 WBC/CC(if obtained 3 hours after the
ater than equal to 175 IU amylase/ dl.
Bacterias on gram stain
Bile (by inspection or chemical determination of bilirubin content)
Food particles (microscopic analysis of stained or spun specimen)

INTERMEDIATE : Pink fluid on free aspiration
50,000 to 1,00,000 RBC/CC in blunt trauma
100 to 500 WBC / CC
75 to 175 IU amylase/dl.

NEGATIVE : Clear aspirate
Less than or equal to 100 WBC/CC
Less than or equal to 75 IU amylase/dl.

Table 2
SPLENIC INJURY SCALE

GRADE	- INJURY DESCRIPTION
I	<p>Haematoma - Subcapsular, non expanding < 10 % surface area</p> <p>Laceration - Capsular tear, non bleeding < 1cm Parenchymal depth</p>
II	<p>Haematoma - Subcapsular, non expanding 10-50% surface area intra parenchymal non expanding < 2cm in diameter</p> <p>Laceration - Capsular tear, active bleeding</p>
III	<p>Haematoma - Subcapsular > 50 % surface area or expanding ruptured subcapsular haematoma, active bleeding</p> <p>- Intra parenchymal haematoma > 2 cm or expanding</p> <p>Laceration - > 3 cm parenchymal depth or involving trabecular vessels</p>
IV	<p>Haematoma - Reputed intra parenchymal haematoma with active bleeding</p> <p>Laceration - Laceration involving segmental or hilar vessels producing major devascularisation (>25 % of spleen)</p>

TABLE 3
GRADING OF HEPATIC INJURIES

GRADE	-	INJURIES DESCRIPTION
I	Haematoma	- Subcapsular, non expanding ,< 10 % surface Area
	Laceration	- Capsular tear, non bleeding < 1 cm deep
II	Haematoma	- Subcapsular non expanding, 10-50 % intraparenchymal, non expanding
	Laceration	- < 3m parenchymal depth < 10 cm in length
III	Haematoma	- Subcapsular > 50 % surface area, expanding ruptured intra parenchymal, haematoma with active bleeding
	Laceration	- > 3 cm parenchymal depth.
IV	Haematoma	- Ruptured central haematoma
	Laceration	- Parenchymal disruption involving 25 to 75 % of hepatic lobe
V	Laceration	- Parenchymal destrucion > 75 % of hepatic lobe

TABLE 4

CLASSIFICATION OF PANCREATIC INJURIES

TYPE	DEFINITIONS
I	Contusion and laceration
II	Distal transection or parenchymal injury with duct injury
III	Proximal transection or parenchymal injury with probable duct injury
IV	Combined pancreatic and duodenal injury Ampulla and blood supply infact Massive injury, ampulla destroyed devascularization.

TABLE 5

CLASSIFICATION OF RENAL INJURIES

- I CONTUSION :** Includes minor cortical laceration and subcapsular haematoma
- II LACERATION :** Usually extends to the parenchyma of kidney
- III FRACTURES :** Involves multiple portion of the kidney in which segments of parenchyma are not in continuity
- IV PEDICLE INJURIES :** Usually occurs following deceleration type injury, rarely with blunt trauma
- V RENAL PELVIS INJURIES :** diagnosis suspected by extravasation dye in IVU and extent confirmed by retrograde pyelography

TABLE 6
AGE INCIDENCE

S. No	Age Group in Years	No of Cases
1	Below 14	5
2	15-29	21
3	30-44	15
4	45 and Above	4

Table 7
Mode of Injury

S. No	Mode of Injury	No. of Cases
1	Road Traffic Accidents	25
2	During Agricultural and Related Activities	14
3	Fall From Height	6

TABLE 8**MODE OF INJURY IN RTA VS NUMBER OF ORGAN INVOLVEMENT**

SL. No	MODE OF INJURY	NO OF CASES	NO. OF ORGANS INVOLVED			MORTALITY
			ONE	TWO	THREE	
1	Direct hit	16	11	4	1	37.5%
2	Run Over	4	2	1	1	50%
3	Thrown out of vehicle	3	3	-	-	0%
4	Vehicle capsize	2	2	-	-	0%

TABLE – 9**PHYSICAL SIGNS**

SL. NO	PHYSICAL SIGNS	OVER STUDY		DAVIS et al	DWIVEDI Et al
		NUMBER	PERCENTAGE		
1	Tenderness	33	73.3%	75 %	91 %
2	Rigidity	24	53.3%	28 %	71%
3	PR Exam Positive	14	31.1%	3 %	-
4	Bowel sounds	29	64.4%	-	60%

TABLE – 10
ASSOCIATED INJURIES

SL. NO	ASSOCIATED INJURY	OUR STUDY		B.L. JAIN et al
		NUMBER	PERCENTAGE	
1	CHEST INJURY	10	22.2 %	11%
2	HEAD AND NECK INJURY	6	13.3%	10%
3	EXTREMITIES	7	15.5%	16%
4	PELVIS FRACTURE	1	2.2%	2%

TABLE – 11
ORGAN INVOLVEMENT

SL. NO	ORGANS INVOLVED	OUR STUDY		DENVER HOSPITAL STUDY	HERMAN HOSPITAL STUDY
		CASES	PERCENT		
1	SPLEEN	22	48.8%	46 %	57.2%
2	LIVER	14	31.1%	33%	46.6%
3	KIDNEY	13	28.8%	-	9,5%
4	PANCREAS	6	13.3%	9%	6%

TABLE – 12

NO. OF ORGANS INVOLVED IN RELATION TO HEIGHT

SL. NO	HEIGHT IN FEET	NO OF CASES	NO. OF ORGANS INVOLVED		NO. OF ASSOCIATED INJURED	MORTALITY %
			ONE	TWO		
1	<10	1	1	-	0	0
2	11-20	3	3	-	2	0
3	>20	2	-	2	1	0

TABLE – 13

DISTRIBUTION OF POTTER ORGAN INVOLVEMENT IN BLUNT

ABDOMINAL TRAUMA

SL. NO	ORGANS	TOTAL NUMBER OF CASES INJURED	ISOLATED INJURY	ASSOCIATED WITH OTHER ORGAN INJURIES	
				Number	Organs involved
1	SPLEEN	22	14	8	Liver – 3 Pancreas – 3 Kidney – 3 Duodenum – 1 Intestine - 2
2	LIVER	14	7	7	Spleen – 3 Kidney – 3 Duodenum – 1 Ileum - 1
3	KIDNEY	13	9	4	Liver – 3 Spleen – 1
4	PANCREAS	6	1	5	Spleen – 3 Duodenum – 1 Intestine - 2

TABLE – 14**MANAGEMENT OF HEPATIC INJURIES**

SL. NO	PROCEDURE DONE	NO OF CASES
1	NON OPERATIVE APPROACH	1
2	HEPATORRHAPHY	10
3	RESECENTIONAL DEBRIDEMENT WITH OMENTAL PACK	1
4	HEPATORRHAPHY WITH PERIHEPATIC PACKING	1

TABLE – 15**INJURY DUE TO ROAD TRAFFIC ACCIDENTS VS AGRICULTURAL WORK**

ORGANS INVOLVED	RTA	AGRICULTURAL AND RELATED ACTIVITIES	OTHERS	TOTAL
SPLEEN	13	6	3	22
LIVER	9	3	2	14
KIDNEY	6	5	2	12
PANCREAS	2	3	1	6

TABLE – 16**NATURE OF AGRICULTURAL INJURIES AND ORGAN INVOLVEMENT**

TYPE OF INJURY	NO OF CASES	ORGANS INJURED
Bull gore injuries	4	Spleen – 2 Liver – 1 Pancreas – 1
Paddy Field Injuries	1	Pancreas – 1 Kidney – 1
Tractor accidents	2	Spleen – 1 Kidney - 2

TABLE – 17**ORGAN RELATED MORTALITY**

NUMBER OF ORGANS INVOLVED	TOTAL NUMBER OF CASES	DEATH	PERCENTAGE OF SURVIVORS
1	21	3	85.7%
2	12	4	66.6%
3	2	5	100 %

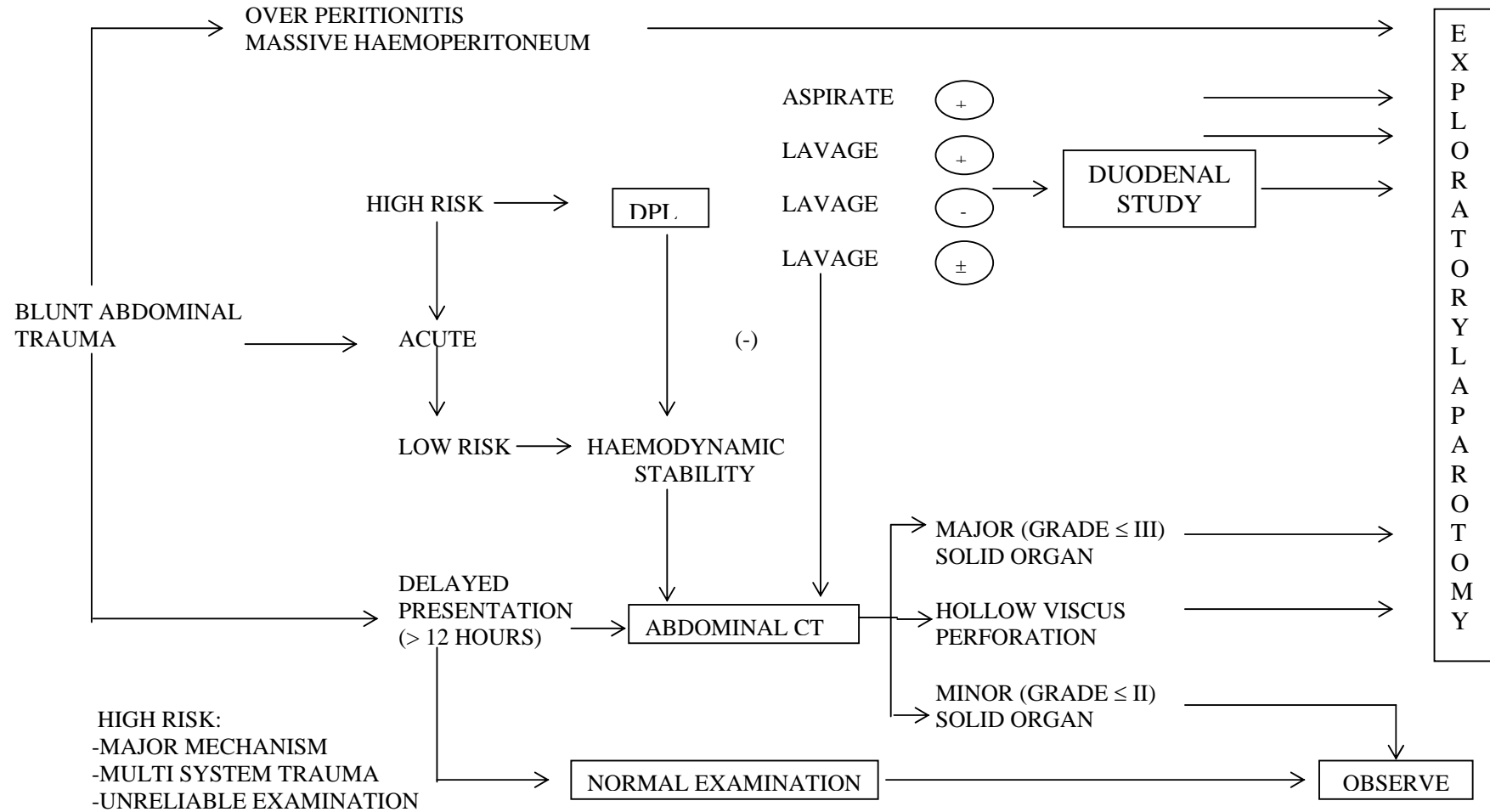
TABLE – 18

MORTALITY DUE TO ASSOCIATED INJURIES

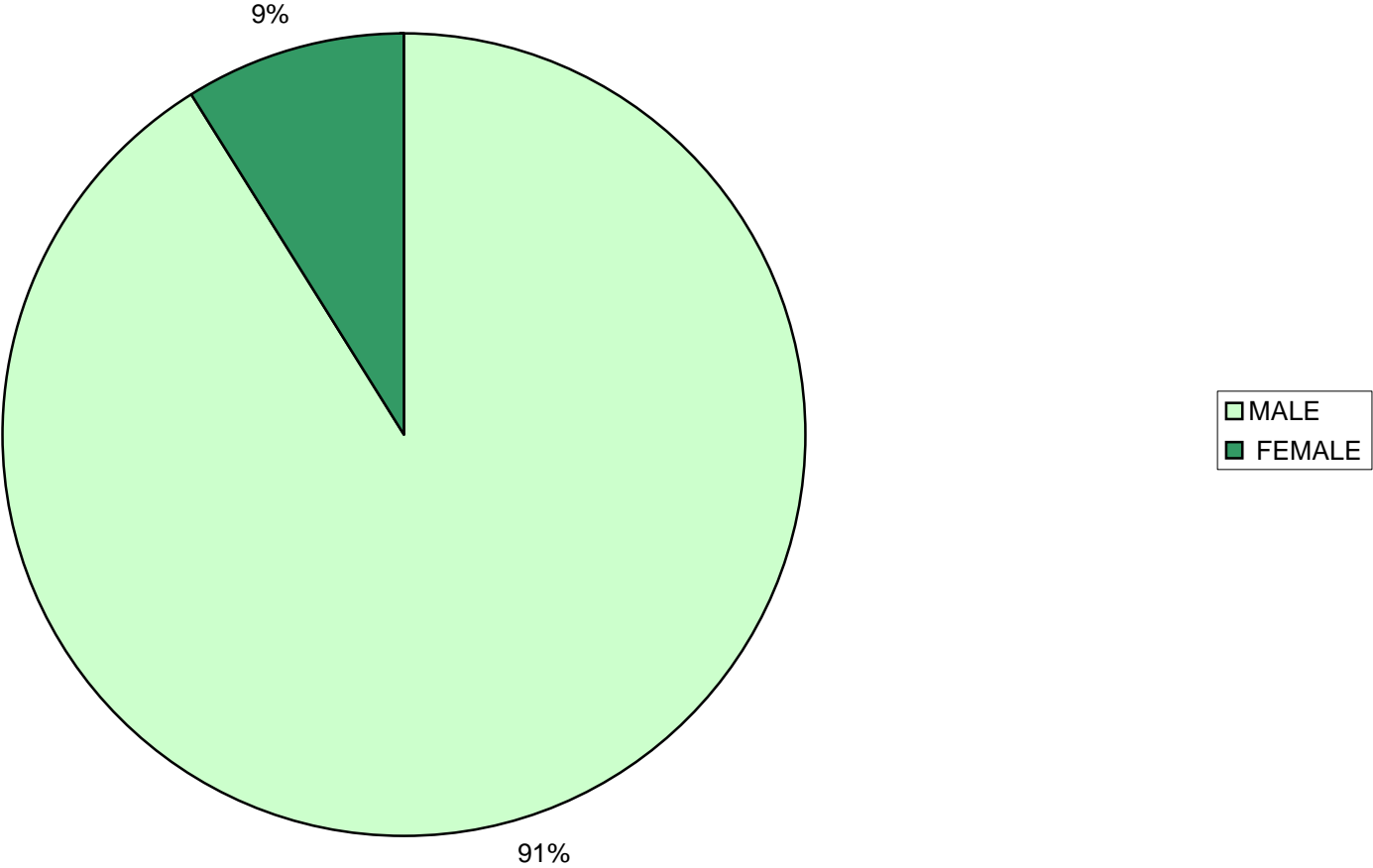
SL. NO	TYPE OF INJURY	NUMBER OF CASE
1	HEAD INJURY ONLY	2
2	CHEST INJURY ONLY	2
3	HEAD AND CHEST INJURIES	1
4	HEAD AND PELVIC INJURIES	1

FIGURE – 1

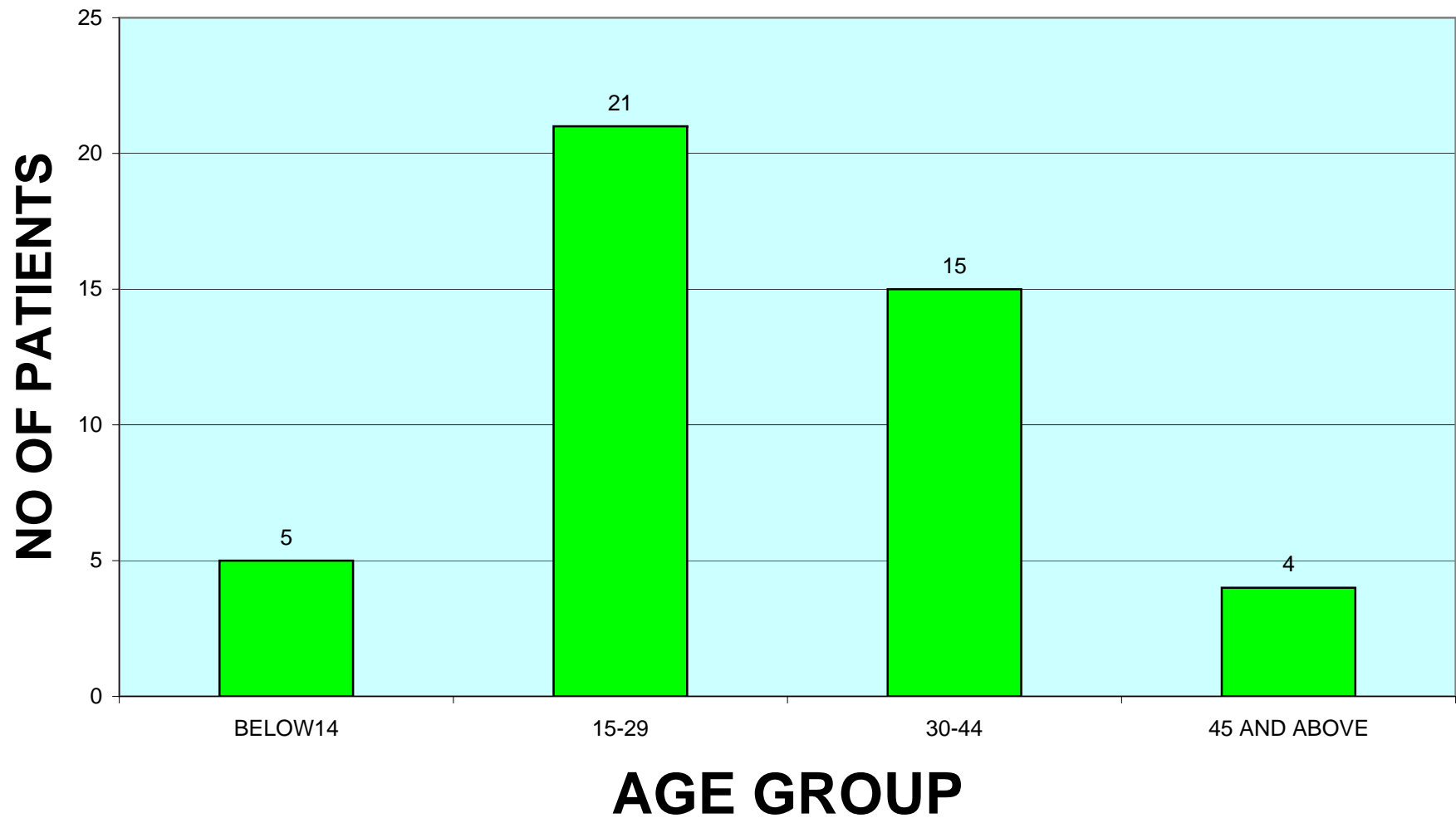
ALGORITHM FOR THE INITIAL MANAGEMENT OF BLUNT ABDOMINAL TRAUMA IN THE ADULT



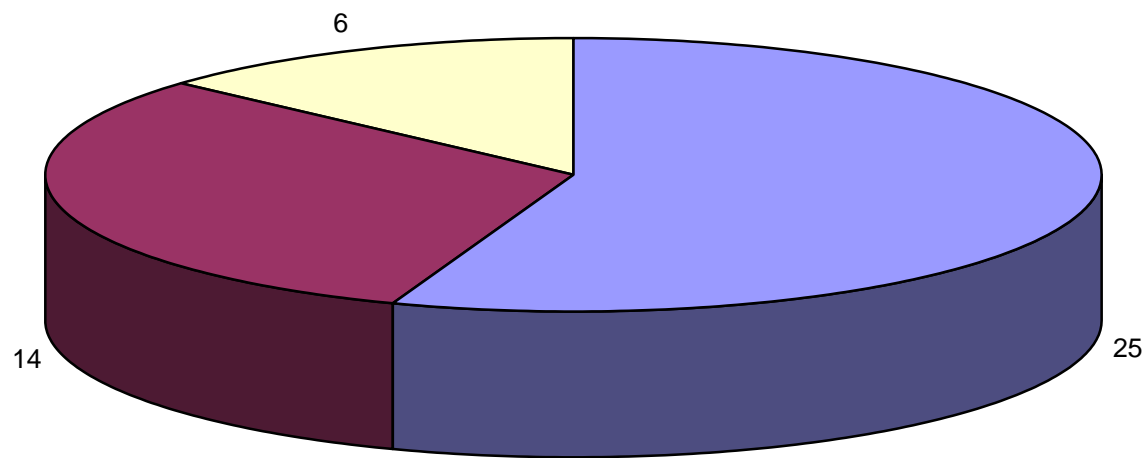
SEX DISTRIBUTION



ACCIDENTS OCCURED - AGE GROUP



MODE OF INJURY



- Road Traffic Accidents
- During Agri & Related Activities
- Fall From Height